In short, what are we going to send and how are we going to send it? Interestingly, digital as well as analog transmission are accomplished using analog signals, like voltages in Ethernet (an example of **wireline** communications) and electromagnetic radiation (**wireless**) in cellular telephone.

## 6.2 Types of Communication Channels



Electrical communications channels are either **wireline** or **wireless** channels. Wireline channels physically connect transmitter to receiver with a "wire" which could be a twisted pair, coaxial cable or optic fiber. Consequently, wireline channels are more private and much less prone to interference. Simple wireline channels connect a single transmitter to a single receiver: a **point-to-point** connection as with the telephone. Listening in on a conversation requires that the wire be tapped and the voltage measured. Some wireline channels operate in **broadcast** modes: one or more transmitter is connected to several receivers. One simple example of this situation is cable television. Computer networks can be found that operate in point-to-point or in broadcast modes. Wireless channels are much more public, with a transmitter's antenna radiating a signal that can be received by any antenna sufficiently close enough. In contrast to wireline channels where the receiver takes in only the transmitter's signal, the receiver's antenna will react to electromagnetic radiation coming from any source. This feature has two faces: The smiley face says that a receiver can take in transmissions from any source, letting receiver electronics select wanted signals and disregarding others, thereby allowing portable transmission and reception, while the frowny face says that interference and noise are much more prevalent than in wireline situations. A noisier channel subject to interference compromises the flexibility of wireless communication.

NOTE: You will hear the term **tetherless networking** applied to completely wireless computer

networks.

**Maxwell's equations** neatly summarize the physics of all electromagnetic phenomena, including cir cuits, radio, and optic fiber transmission.

$$\begin{aligned}
\bigtriangledown \times E &= -\left(\frac{\partial}{\partial t}(\mu H)\right) \\
div(\epsilon E) &= \rho \\
\bigtriangledown \times H &= \sigma E + \frac{\partial}{\partial t}(\epsilon E) \\
div\,(\mu H) &= 0
\end{aligned}$$

(6.1)

where *E* is the electric field, *H* the magnetic field, $\epsilon$ dielectric permittivity, μ magnetic permeability, σ electrical conductivity, and ρ is the charge density. Kirchof's Laws represent special cases of these equations for circuits. We are not going to solve